Cluster annual report - 2018

CC4.1 – Demand-led approaches to drive postharvest innovation and nutrition improvements.

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MAIN ACHIEVEMENTS

A study was undertaken to develop and validate calibration equations on the Near-Infrared Reflectance Spectrophotometer (NIRS) for determining chemical compositions of selected yam genotypes. Equations developed for moisture, ash, protein, crude fiber, and tannin showed high coefficients of determination (R^2) for the calibration curve (0.87, 0.84, 0.83, 0.80, and 0.89, respectively) and high to medium coefficients of determination in cross-validation (0.80, 0.68, 0.69, 0.68, and 0.50). The standard errors of calibration (SEC) and the standard errors in cross-validation (SECV) were low for most constituents. A total of 360 ascensions of yam flour were predicted for selected traits to test the equations, and the results were comparable with data from conventional methods. Results of this study have shown that NIRS could be a very useful tool to help yam breeders screen large sample sets using limited resources with very short time. This will enhance breeders' rapid selection of genotypes at screening stage where many breeding lines are to be evaluated within the shortest time possible. A total of 164 cassava genotypes cassava roots were obtained from the experimental plots of the cassava breeding program of IITA from five different locations namely; Ibadan, Ubiaja, Umudike, Ikenne and Abuja respectively. The selected 164 cassava samples were used to construct the near infrared spectra models using the Win ISI 4 Project Manager by using the modified partial least squares (MPLS) regression and cross validation techniques to calculate the correlation between spectral data and laboratory data. Statistical methods applied in the study included the coefficient of determination calculated in cross-validation (R2cval) and the standard error of calibration (SEC), the standard error of cross-validation (SECV), and the standard deviation. Also, the ratio of prediction to deviation (RPD), which indicated the correlations between the SD of the standard wet chemical analyzed data and prediction data by NIRS model (SECV or RMSEC) (Williams & Sobering, 1996), was applied to estimate the prediction ability of the model. The developed calibration equations had good coefficients of determination for the for most of the proximate parameters (Moisture; r2= 072, Ash; r2= 0.77, protein; r2= 0.50 and crude fiber; r2= 0.54. Coefficient of determinations for Amylose (r2= 0.21), sugar (r2= 0.18) and starch (r2= 0.16) were not good enough which implies that the equations for these parameters can be improved by inclusion of other genotypes to expand the calibration equations. (This deliverable has been accompanied by documentation (uploaded in MEL) ready to be shared with the public

A preliminary study on matooke leading to extend postharvest storage was initiated in 2018 in Uganda. Four matooke varieties were obtained from NARL's experimental field and fruit taken at optimum harvest stage based on visual aspect. Fruits were further treated with different concentrations of 1-MCP (1-methylcyclopropene), an ethylene inhibitor. Their physiological status was monitored during postharvest storage through a measurement of ethylene, CO_2 and O_2 gaz production using a portative 3 gaz analyzer. Our preliminary data showed that treatment with 0.5 ppm of 1-MCP extended matooke green life by at least two additional days as compared to control untreated fruit. While these results suggest a putative effect of the 1-MCP, they should nevertheless be confirmed by the measurement of other ripening indicators (softening, soluble sugar content, organic acid, etc.) and on fruit physiologically comparable at harvest.

Utilization of water yam (*D. alata*) is usually in fresh form to make some dishes such as Ikokore and Ekpang Nkukwo. Also, traditionally, water yam is processed into flour by peeling, cutting into chunks, par-boiling and sun-drying for 3-4 days. The chunks are usually milled into fine flour, which

is cooked in boiling water to make a thick paste, called Amala. However, Amala from water yam is less preferred compared to that from *D rotundata*. Few attempts have been made to expand the uses of water yam. Expanded utilization opportunities through water yam processing into novel or convenience food products and improvements in the marketing channels can influence the productivity of water yam and bring the benefits from the crop to a broader range of consumers. We investigated the consumer acceptability of novel products from water yam. Seven varieties (TDA 00/00194, 02/00194, 297, 291, 01/00090, 00/00064 and 02/00045) were used for the study. The varieties were processed into flour for the determination of quality characteristics and into novel products. A total of thirteen products were developed; five tuber-based and eight flour-based. Each of the products were subjected to sensory evaluation by 12 semi-trained panelists. Each panelist received sample from the seven selected varieties, coded with a three-digit number. They were asked to rank each sample according to preference for quality attributes. The scale for acceptability ranking was given as 1 = liked extremely and 5 = disliked extremely. Results obtained indicate that products made from varieties with high starch content were more accepted although some variations were reported due to color difference.

CIP with partners has worked successfully on iron (Fe) in-vitro bioaccessibility evaluation in biofortified potato clones but there is still a research gap to which level potato Fe is bioavailable in humans. Bioaccessibility from potato Fe was found higher than from beans, pearl millet and other crops and given the high ascorbic acid and low phytate concentration in potatoes it is expected that potato Fe bioavailability will be high as well indicating a significant positive impact on biofortified potatoes consuming human populations. To validate that hypothesis, CIP will conduct a study using stable isotopes to determine Fe bioavailability in humans starting in 2019. In 2018, we needed to select and to produce enough tubers of 3 selected clones and one control variety. After propagation, 300 seed tubers of each selected biofortified clones and the control variety were available by October 2018 and have been re-planted to obtain enough tubers which will be used for the feeding trial in 2019.

OUTCOME CASES AND POLICY INFLUENCED (PROPOSED)
Revise and complete the suggested list of outcome cases and policies to be documented

Title of Outcome/ Impact Case Report (OICR) (30 words)	Description (up to 80 words)	Geographic scope (Specify if regional, national, sub-national and provide list of regions/countries)
'Postharvest Losses and their Determinants: A Challenge to Creating a Sustainable Cooking Banana Value Chain in Uganda'	A framework for estimating the average physical and economic losses at the different value chain nodes and the total losses in the entire chain is proposed, and separate approaches to identify the determinants of PHL at farm and retail levels were employed. Authors suggest that sensitizing key value chain stakeholders on PHL and their economic implications and involving them in the co-creation of strategies that are aimed at minimizing such losses is urgently	Uganda

Title of Outcome/ Impact Case Report (OICR) (30 words)	Description (up to 80 words)	Geographic scope (Specify if regional, national, sub-national and provide list of regions/countries)
	required. Doing so will result in higher value chain efficiency, and, consequently, lower costs that can translate into higher trader margins and lower consumer prices, making production of banana more sustainable.	
Assessment of banana peels, cassava leaves to reduce greenhouse gas emissions (GHG)	Tests of animal feed made with RTB by-products to reduce greenhouse gas emissions of cattle, compared to conventional feed formulas (maize-based)	Global
Sweetpotato silag-based feed for dairy cattle	Experiment to test efficacy of silage as a supplement for dairy cattle. Effect on milk production, animal body weight, and cost saving.	Global
A leaflet on recipes for the novel yam products	A total of 24 snack products were developed from selected varieties. These products are yam fritters, yam strips, yam flakes, yam chin chin among others. A recipe booklet has been compiled and available to next users.	Global

Name and description of policies modified in design or implementation, informed by CGIAR research (20-50 words, ideally around 30 words)	Type (policies/ strategies / laws/ regulations/ budgets/ investments/ curricula)	Whose policy is this? The primary organization(s) either designing/promulgating the policy, law, investment (e.g. national government) etc. and/or within which it is operating.	Geographic scope (Specify if regional, national, sub-national and provide list of regions/countries)

MAIN ACHIEVEMENTS WITH GENDER RELEVANCE

The Participatory Market Chain Approach (PMCA) is a value chains method that stimulates innovations which can improve participation of smallholder chain actors. However, the PMCA was gender blind and hence fell short in inclusion of women and vulnerable groups in market chain interventions. To address this shortfall, gender analytical tools were developed, and others adapted. The tools have been used extensively in east Africa and Latin America. Following two intense years of application on various chains, four tools were reviewed and validated. Two tools were deemed ready for use, while two tools need more internal review. A technical report describing the validation process and provides recommendations on improving the tools that need more internal

review was submitted. Findings were also shared during the annual CGIAR Gender Conference. The validation proved useful in introducing and adapting gender analytical tool in value chain research.

MAIN ACHIEVEMENTS WITH YOUTH RELEVANCE

The dairy sector in Uganda is challenged with low production & productivity resulting from limited access to feeds, among others. It has been shown that farmers who supplemented sweetpotato vine silage (SPVS) to their dairy cows reported improvement in milk yield of 1-2 litres/cow/day. Based on these findings, a CIP-led study was conducted at Sight Farm, Wakiso district, central Uganda to verify and assess the effect of supplementation of SPVS on dairy cattle. The sweetpotato silage used in this trial was produced by a youth group which has continued to sell quality SPVS to pig farmers. A Latin square design (4 animals x 4 treatments) was applied to early lactating mono-parous crossbred Friesian dairy cows. Preliminary results indicate an average increment in milk production of 1.5 litres/cow/day; and 1 kg increase in live body weight per cow per day. From the findings, a supplementation level of 6kg/cow/day is recommended. This would result in a financial gain of up to 0.4$ per cow per day, provided the farmer produced his own silage and the price of milk averaged at 0.28$/liter. These results augur wider utilization of SPVS by smallholder livestock farmers – especially women who practice zero grazing. The research has gained a lot of excitement amongst dairy farmers and media articles/items have already been broadcasted. SPVS will create more job opportunities for youth to (i) train commercial dairy farmers in silage production and (ii) produce and sell more silage to small scale dairy farmers. The final technical report and manual (Sweetpotato vine silage for small-scale dairy farmers) will be ready for sharing in 2019.

MAIN ACHIEVEMENTS WITH CAPACITY DEVELOPMENT RELEVANCE

There was completion of a MSc thesis on the changes in the quality of two banana and one plantain genotypes during maturation; including: changes in the physical aspects of the fruits (shape, color), changes in the composition of the fruits and changes in the quality of the starch (PDF of the thesis available). This is the first time the maturation of Musaceae genotypes from Colombia have been characterized at a high level of details.

Micronutrients are essential component of good nutrition and the deficiencies in human diets are responsible for many health problems in the world. Biofortification of staple crops such as cassava is a novel food-based approach that has been adopted to address this challenge. Thus, this study investigated the retention and bioavailability of beta-carotene, iron and zinc in *fufu* produced from yellow-fleshed cassava roots grown in Sierra Leone. Six yellow-fleshed (TMS-070557, TMS-011371, TMS-011412, TMS-011663, TMS-083724, TMS-083774) and one white (TME 419) genotypes of cassava roots were processed into *fufu* using conventional (oven and sun dried) and traditional (bowl and river) methods. The effects of processing and genotypes on the concentrations and percentage true retentions were assessed. Proximate (moisture, protein and crude fibre), minerals (calcium, potassium, sodium and magnesium) and anti-nutritional (cyanide, tannin and phytate) contents of the *fufu* were determined using standard laboratory methods. Quantitative descriptive analysis was used to determine the sensory profile of the *fufu* before selecting five of the samples for consumer acceptability. Bioavailability of beta-carotene, iron and zinc were determined using *in-vitro/*Caco-*2-*cell uptake and animal model. Data were analyzed using means, percentages, analysis of variance and means separated using Duncan's multiple range test. Mean moisture, protein and crude fibre contents of *fufu* ranged from 2.9 to 9.9%, 1.4 to 4.4% and 1.9 to 13.0% respectively while calcium, potassium, sodium and magnesium contents were 279.71-1428.71mg/kg, 570.20-3736.80mg/kg, 11.03-31.07mg/kg and 120.52-656.43mg/kg, respectively. The cyanide, tannin and phytate contents ranged from 1.04-2.45mg/100g, 1.22-1.39mg/100g and 1.07-2.21mg/100g. Mean

values of total beta-carotene concentration and percentage true retention were highest in traditional river method: 11.06μg/g, (46.77%) and 4.54μg/g (16.94%) for both raw and cooked *fufu* samples than all the other methods. Sun-dried *fufu* samples had significantly (p<0.05) higher concentration and percentage true retentions of iron 10.01mg/kg (18.02%) and 11. 49mg/kg (40.64%) in the raw and cooked *fufu* samples, respectively. Genotype TMS – 083724 had the highest total beta-carotene but had the least iron and zinc concentrations and percentage true retentions compared to all the other genotypes. Significant differences (p<0.05) were observed in the sensory and consumer acceptability of the samples. The traditional river method samples had significantly higher (p<0.05) ferritin value relative to the other processing methods. The animal model revealed a significant difference (p<0.05) in the plasma and liver beta-carotene between the groups. The overall iron bioavailability expressed as hemoglobin regeneration efficiency from *fufu* ranged from 2.7% to 4.6%. Mean plasma zinc concentration increased from 3.50-4.98μg/dl in the mice indicating zinc bioavailability. In conclusion, beta-carotene, iron and zinc concentrations and percentage retentions were dependent on genotype and processing methods which have substantial effects on the *fufu*. Genotype TMS – 083724 and traditional river processing method had appreciable bioavailability values for beta-carotene, iron and zinc. Public awareness and adoption of biofortified *fufu* into the food system of Sierra Leone is therefore recommended. This is a PhD thesis.

Malnutrition among under five children in most developing countries is due to poor infants and young child feeding practices. The absence of nutrient dense complementary foods necessitated enrichment of traditional complementary foods. This study evaluated nutrient contents and bioavailability of micronutrients in complementary foods enriched with groundnut in Eastern and Northern regions of Sierra Leone. The study identified sixteen traditional complementary foods commonly consumed in the regions and their recipes by administering semi-structured questionnaire to 800 mothers and caregivers at household level using simple random sampling. Ten of the collected recipes were standardized and analyzed for proximate (protein, fat and fibre), functional (Dispersibility, Water Absorption Capacity and Swelling Power), minerals (Iron, zinc and calcium) and anti-nutritional factors (tannin, phytate and trypsin-inhibitors) using standard laboratory methods. Three of the traditional complementary foods (rice, maize and cassava *pap*) were enriched with groundnut at 10%, 20% and 30% substitution levels while industrial Bennie-mix was used as control and assessed for nutrient and anti-nutritional factors. Sensory evaluation was conducted using a 9-point hedonic scale while protein quality and bioavailability of iron, zinc and vitamin A contents of the enriched foods were determined using animal model. Data were analyzed using means, percentages, analysis of variance and means separated using Duncan's multiple range test. Results revealed that common recipes were homemade benni-mix (41.2%), rice-pap (26.0%), maize-pap (5.8%) and cassava based pap (4.5%). The range of protein, fat and fibre contents of standardized complementary foods were 8.3% - 16.9%, 4.8 % -17.2% and 3.1% -7.2%, while tannin, phytate and trypsin-inhibitors were 1.19 – 3.83mg, 0.61 – 3.76mg and 0.26 – 5.79mg respectively. Iron, zinc and calcium contents were 0.13 – 2.32mg, 0.12 – 0.56mg and 0.17 – 11.63mg respectively. Dispersibility (68.7% – 71.5%), Water Absorption Capacity (1.38 – 2.13ml) and Swelling Power (15.01% – 36.7%) of the products varied. Protein content of the enriched products ranged from 12.9% to18.5%, ash (0.9% - 1.8%), Fat (2.9% – 14.5%), fibre (1.9% – 4.3%) and energy (361 – 424. 59kcal per 100g dried flour). Isoleucine, Lysine, Leucine and Methionine were (1.00 – 4.50g), (1.50 – 5.5g), (1.50 – 9.50g) and (1.00 – 4.00g) respectively. Phytate ranged from 1.42 to 3.38mg/100g, tannins 1.4 to 3.3 mg/100g and trypsin inhibitor 0.41 to 5.94mg. Sensory evaluation showed that complementary foods enriched with 20% groundnut had the best acceptability compared with the industrial Benni-mix product. There was significant (p≤ 0.05) improvement in the mineral contents of the enriched complementary foods than the industrial Benni-mix commonly used in Sierra Leone.

Protein Efficiency Ratio in rat ranged from 0.46 to 6.64g, Feed Efficiency Ratio (0.2 - 0.8%), True Digestibility (6.6 to 42.1%) and Net-Protein Retention (0.2 to 6.9%). Hemoglobin status after depleted/repletion indicates that the micronutrient was well absorbed and utilized. In conclusion, the traditional complementary foods enriched with 20 and 30% groundnut meet WHO standards for energy, protein, iron and zinc. These enriched complementary foods could be recommended for adoption at household levels to reduce child malnutrition. This is a PhD thesis.

MAIN ACHIEVEMENTS WITH CLIMATE CHANGE RELEVANCE

No studies with climate change relevance were conducted during the reporting period.

MAIN GAPS AND CHALLENGES

Describe the main challenges/bottlenecks encountered and the deviation from your annual plan of work.

There were no main challenges/bottlenecks encountered or deviation from the planned activities that were encountered.

Please list any relevant review or study on foresight, monitoring and evaluation that has been realized in the last 12 months at the project/cluster level and that has potentially not been implemented under cluster CC5.1-Foresight and Impact assessment (Use Annex 2 to provide this list). Provide results from these evaluations and learning processes, if any.

No studies on foresight, monitoring and evaluation were realized during the reporting period.

MEASURES TAKEN AND ADJUSTMENTS PROPOSED

Describe action taken to address challenges/bottlenecks

Provide an update on your theory of change if this is part of the adjustments proposed

There is no update to be provided as there were no adjustments with regard to the theory of change.

PARTNESHIPS: ACHIEVEMENT AND CHALLENGES

Please list up to three important partnerships for 2018, using the following table.

Brief description of partnership aims (30 words)	List of key partners in partnership (one or more partners). Do not use acronyms.	Main area of partnership (may choose multiple), Research/Delivery/Policy/Capacity Development/Other, please specify
To create linkage with a farmer dairy association with the aim of introducing SPVS as an alternate supplement feed to other dairy farmers in central Uganda and beyond	Sight Farm Dairy Farmers Network (DAFAN)	Research and delivery

Strengthen linkage with youth group to reach out to youth	Bavubuka Twekembe Youth Group	Delivery
Iron bioavailability study on biofortified potatoes	Quadram Institute Biosciences Norwich, UK	Research

Please include collaborations with one or more CRPs or Platforms – or in some cases with other Centers, if these are not already core partners for your CRP.

Name(s) of collaborating CRP(s), Platform(s) or Center(s)	Brief description of the collaboration	Optional: Value added, in a few words e.g. scientific or efficiency benefits

FUND RAISING

Give a narrative summary on the financial status and health of the cluster (all windows).

Provide an update on fund raising efforts.

ANNEX 1 – OUTPUTS TO BE REPORTED

Related output(s)	Output leader	Completed in MEL (YES/NO)
CC4.1.1.1-Product based consumer profiles within countries, as well as regional profiles where products may overlap built and set up	Busie Maziya-Dixon	Yes
CA4.1.1.2-The nutritional, bioactive, functional, anti-nutritional properties of RTB and understood, and establish relationship between these properties to sensory properties and end-users' preferences.	Thiery Tran	Yes

Annual milestones related to outputs are:

Biochemical traits for consumer preference and micronutrient profiles for RTB defined

ANNEX 2 – LIST OF FORMATIVE AND EVALUATIVE STUDIES

Title	Deliverable code
	Please make sure that the study has been uploaded in MEL